“STUDIES ON ALGAL BIODIVERSITY OF TAWARJA DAM FROM LATUR DISTRICT, MAHARASHTRA”

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A] Title of the proposed Research

"STUDIES ON ALGAL BIODIVERSITY OF TAWARJA DAM FROM LATUR DISTRICT, MAHARASHTRA"

Abstract

Algae play an important role in the ecological balance of aquatic ecosystem. The continuity of biota depends on photosynthetic activity of these organisms. The quantity and quality of the algal flora is affected by many ecological factors. Algal flora of different habitats found variable due to change in environmental factors. Each and every habitat shows particular algal diversity. Stable and undisturbed ecosystem normally allows growth of large number of species which are distributed with an equal dominance. Diversity may change due to some unfavorable environmental factors. Decline in biodiversity are greater in fresh water than in the most affected terrestrial ecosystem. Therefore it is essential to study taxonomy and biodiversity of algal flora. The quality of surface water has progressively worse in many countries in the past few decades. As a result of the growing population, urbanization, agriculture and increasing in industrialization, the inland water bodies are confronted with the increasing water demand, as facing with extensive anthropogenic emissions of nutrients and sediments, predominantly the lakes and reservoirs. To resolve this problem, it is necessary to carry out water quality assessment, planning and management, in which water quality monitoring plays an important role. The present study is aimed at assessing the water quality of Tawarja dam used for irrigation, livestock watering and fish production. The proposed research work will carries taxonomy, ecology, algal diversity and physico-chemical studies of Tawarja dam from Latur district in the Marathwada region of Maharashtra.

B] Introduction:

Algae are important as primary producers of organic matter at the base of the food chain. They also provide oxygen for other aquatic life. Algae may contribute to mass mortality of other organisms, in case of algal blooms, but they also contribute to economic well-being in the form of food, medicine and other products. In tropical regions, coralline algae can be as important as corals in the formation of reefs. They may forms important constituent of human food (diet) in future. In future when world population will be very much, to provide them all nutritious food, algae will be used as alternate source of energy.

Algae are the large and diverse group of plant kingdom comprising simple, typically autotrophic organisms, ranging from unicellular to multicellular forms. It is a photosynthetic form of life found abundant in aquatic and terrestrial ecosystems of nature. They are found in variety of habitats such as fresh water, marine water, on snow, on rocks, on or in soil and also on the bark of tress. They are with different coloured pigments like green, blue-green, pink, red etc. It is well known fact that algae with the help of pigment complex and in the presence of carbon dioxide and water, convert effectively solar energy into biochemical energy. Algae being phototrophs are capable of chief food supplier for most of the small aquatic animals, which in turn are consumed by the bigger animals. This form the basic food chain in any

aquatic ecosystems and large number of such food chains are interlinked to form food web. For such web algae serve as a chief source of food.

Review of literature reveals that, studies on algal taxonomy in abroad and in India have been done extensively by many research workers. In Maharashtra tremendous work has been done in past few years on algal taxonomy by various workers. (Krishnamurthy (1977), Deore (1978), Gunale (1981), Pingle (1981), (1988,1990,1993),Sagar (1987),Bodas (1991), Nandan and More (1999),Ansari (1997) ,Pendase (2000), Balkrishanan and Chaugale (2000), Mahajan (2001). In Marathwada region of Maharashtra except few reports (Ashtekar (1980),Jadhav (2007), Kamble (2008), Andhale (2008), Talekar (2009), Yadav (2010) very rare attention has been paid towards algal taxonomy, although the climatic conditions of Marathwada region are most suitable to grow algae luxuriantly and in diverse form, therefore to fulfil this lacuna, it has been decided to work on taxonomy ecology and biodiversity of algae of Tawarja dam of Latur district in Marathwada region of Maharashtra. Such type of regional study is very important, with a view of further work on algal flora of the Latur district.

In early days, water was primarily used for domestic needs like drinking, washing, bathing and cooking etc. But due to industrial and urban development, requirement of water for these activities has increased along with domestic purpose. Water of good quality is required for living organisms. The quality of water is described by its physical, chemical and characteristics. But if, some correlations were possible among these parameters, then significant ones would be fairly useful to indicate the quality of water (Dhembare et.al, 1997).

The deterioration of quality, loss of biodiversity and fast depletion of water resources are the main challenges, which need urgent attention. The ecological study gives the proper direction in decision-making processes for problems like pollution control, fish and other aquatic lives. This represents the organic material available in particulate form on which the animal population of aquatic ecosystem depends directly or indirectly. The studies of physico-chemical parameters are used to detect the effects of pollution on the water quality.
Assessment of physico-chemical and biological parameters serves a good index in providing particular status to a water body. Algae are ecologically important as well as they are known to produce more oxygen than all plants in the world put together. Though the knowledge of algal forms in rivers in India is limited but recently phytoplankton of fresh water rivers have been studied in detail (Mishra et al., (2002), Jafri and Gunale (2006), Shashi Shekhar et. al., (2008), Annalakshmi and Amsath (2012). The assessment of water quality using phytoplankton diversity and their association as biological indicators has been carried out by several workers,(Chaturvedi et al. (1999). Seasonal variation of algal forms in lakes and rivers is presented by many researchers (Kaur et al., (2001), Jarousha (2002), Tiwari and Chauhan (2006). Algal biodiversity of water bodies have been studied by several workers in India.(Anuja and Chandra (2012); Das and Adhikary 2012; Jadhavar and Papdiwal (2012).Algal members are rich in different physiochemical (Bharadwaj et. al. (2014). Distribution of algae and their variation at different zones of a water body is influenced by physicochemical parameters of water. The algal growth in a habitat influences the ecosystem and responds rapidly to changes in the aquatic environment particularly in relation to nutrients.

The present investigation is carried out to assess the diversity status of Algae along with the physico-chemical parameters of Tawarja dam.

C] Review of literature including International and National status.

All over the world extensive and appreciable work have been carried out by the phycologist on taxonomy, ecology and algal biodiversity. A brief account of algal taxonomy ecological studies in Abroad, India and Maharashtra is given below.

i) Brief resume of publications on taxonomy ecology and biodiversity of algae have been appeared in Abroad:(International Status)

Fritsch (1903) observed phytoplankton of river Thames. Allen (1920) made a quantitative and statistical study of the plankton of the Sanjoaquin river and its tributaries in California, Smith (1920) studied the ecology of plankton algae form inland lake of Wiscosin. Crow (1923) studies the taxonomy and variation of *Microcystic* in Ceylon, Griffiths (1926) studied phytoplankton of the lowland waters of Great Britain. Classen (1927) worked on biological studies of polluted areas in Genesee river, New York. Butcher (1947) investigated the algae of organically enriched waters of Trent and river Tame. Hisano and Minoru (1950, 1953) studied the plankton desmids from Lake Biwa, Japan. They reported 61 taxa of desmids. Hilliard (1959) while determining the phytoplankton of Karluk lake from Kodiok Island, Alaska and found 255 taxa of algae belonging to 84 genera. Woodson and Prescott (1961) studied algae of the James river basin, Virginia and correlated the water quality with occurrence of phytoplankton. Woodson and Holoman (1964) worked systematic and ecological study of algae in Chesterfield country, Islam and Haroon (1980) recorded 201 taxa of desmids form lakes in Dacca. Moore (1980) observed seasonal succession of phytoplankton in yellow knife Bay Great Slave Lake. Nazneen (1980) observed the influence of hydrobiological factors on seasonal abudance of Phytoplankton in Kinjhar lake, Pakistan. Gophen and Nishri (1994) carried out algal abundance study from lake Israel. They reported 250 species belonging to Chlorophyceae, Diatoms and Cynaophyceae. Zekeria and Gurbusz (1996) studied composition and seasonal variations of algae from Tercan dam, Turkey. They recorded dominance of Bacillariophyceae and shown abundance of total algal flora in winter and summer season. Sophia (1999) studied desmid taxonomy of Brazil lakes. Nogueria (2000) reported the dominance of *Anabaena spiroides* in winter and *Microcystis aeruginosa* in summer while working on Juruminim reservoir, Sao Paulo, Brazil.

ii) Brief resume of publications on taxonomy ecology and biodiversity of algae have been appeared in India:(National Status):

Ghose, S.L. (1923) studied systematic and ecological account of collection of blue-green algae at Lahore and Simla. Ganapati (1940) studied the ecology of temple tank and found permanent blooms of *Microcystis.* Das and Srivastava (1956) investigated correlation between hydrobiological factors and planktons. Venkatraman (1957) studied algal flora of the ponds at Banaras. He reported 61 forms representing 38 genera. Singh (1960) worked on ecology of phytoplankton in inland waters of Uttar Pradesh. Zafar (1959, 1964 a, b, 1966, 1967, 1968), worked on taxonomy of lakes, Physico chemical factors of ponds and also studied limnology of Hussain Sagar. Hyderabad, Andhra Pradesh. Rai (1962) carried out hydrobiology of river Yamuna at Okhala, Delhi. Kamat (1962) reported 126 taxa of Chlorophyceae from Ahmedabad. Moitra and Bhattacharya (1965) studied some hydrobiological factors affecting plankton production in fish pond at Kalyani, West Bengal.. Anand (1975), presented a check list of phytoplanktonic algae from Mansar lake, Jammu. He enumerated 25 taxa. Hosmani and Bharti (1975), carried out hydrobiological studies on Ponds and lakes of Dharwad, Karnataka. Govindan and Sundersen (1979) studied seasonal succession of algal flora in Adyar river, Madras. Dakshini and Gupta (1979) studied

limnology of three fresh ponds around Delhi. They reported 29 taxa of algae as pollution indicators, Nandan and Patel (1983a,b,c 1984a,b, 1985a,b,d, 1986,a,b) extensively worked on physicochemical properties, ecology, taxonomy and seasonal variations of algal flora of Vishwamitri river, Fatma (1885) recorded epiphytic algae from fresh water ponds of Lucknow. Hegde (1988a, 1988b) while working on limnological studies of ponds of Dharwad, Karnataka and recorded 83 taxa of algae..Eswari (2002) worked on hydrobiological studies of red hills reservoir, North Chennai, Tamil Nadu. Murlidhara *et. al.*, (2002) studied *Physico-chemical* properties and phytoplankton diversity of Tumkur tank, Karnataka, Bharti and Ramanibai (2002) studied Hydrobiological characters of Kolvia Lake, Chingleput district,Chennai.

iii) Brief resume of publications on taxonomy ecology and biodiversity of algae have been appeared in Maharashtra:

Hate (1909) reported two species of *Chara* from Bombay Island.Apte (1936), Dixit (1931, 1935, 1936, 1937, 1940, 1942) extensively worked on Charaphytes Myxophyceae and Chlorophyceae of Bombay Presidency. Kamat (1962, 1962a, 1962b, 1962c, 1962d, 1963, 1963a, 1963b, 1964, 1967, 1968, 1974, 1975, 1975a) recorded two species of *Chroococcidiopsis* and *Oedogonia*, Chlorophyceae, Euglenophyceae, Cyanophyceae of Ahmedabad, Panhala, extensively worked on algae of Kolhapur, Mahabaleshwar, Alibag, Marathwada, Vidarbha and desmids of Marathwada. Marathe (1967, 1969) studied on soil algae of Dhule and Jalgaon. Gonzalves and Jain (1970) while working on algal flora of Thana district, they reported some Oedogoniaceae. Rana (1977) clearly showed effects of industrial and domestic effluents on algal flora and water quality.Ashtekar and Kamat (1978, 1979, 1979a, 1979b and 1979c) studied on Oedogoniaceae and Zygnemataceae of Aurangabad. Ashtekar (1980) systematically studied fresh water algae of Aurangabad district and recorded 617 algal taxa. Gunale and Balkrishanan (1981) have used algae as biomonitors of eutrophication in the study of Pavana, Mula and Mutha rivers at Pune city. Prasad and Singh (1980), Agrawal (1983), Sing and Sing (1994) studied algae with response to physicochemical characteristic from various rivers and reservoirs of India. Pingale (1981) studied on ecology of algae of Pam river in Poona . Jagdale *et. al.,* (1984) studied the pollution of Godavari river water at Nanded. Mahajan and Mahajan (1988) studied the algal communities in Velhala lake near Bhusawal and used algae as indicators of organic pollution. Singh (1992) observed water quality index of some major rivers of Pune, Maharashtra.Hosetti *et. al.,* (1994) observed water quality in Jayanthi nalla and Panchagana river at Kolhapur. Goel and Autade (1995) on the ecological studies on the river Panchganga and analyzed water for nitrogen, phosphorus, chloride, sulphide, COD, clearly reveals the polluted nature of the river. Mishra(1980) and More(1997) studied hydrobiological characteristic rivers and dams in relation to plankton, productivity and pollution. Nandan and Ansari (1999) carried out ecological study of algae from Mausam river flowing through Malegaon city. Thorat and Masarrat (2000) observed pollution status of Salim ali lake, Aurangabad. They reported the lake was highly polluted. Gaikwad and Gunale (2001) studied water quality monitoring of river Godavari from Nashik region and use pollution pool index.Sathe *et. al.,* (2001) made hydrobiological studies on Ped and Siddewadi reservoirs form Tasgaon. More and Nandan (2003) evaluated Panzara dam water for hydrobiological study of algae.. Sirsat *et. al.,* (2004) studied phytoplankton of fresh water pond at Dharamapuri, Beed. Patel and Bhadane (2004) gave comparative account of plankton diversity from Tadya pond of Amalner district Jalgaon. Ansari and Nandan (2005) studied eutrophication of Mausam river with relation to algal biodiversity..Khapekar and Deshpande (2007) studied the phytoplankton composition and assessed the pollution status of Naik lake, Nagpur. Nandan *et. al.,* (2007) recorded 322 algal forms from Hartala lake of river Tapi.. Jadhav *et. al.,* (2007) studied algal diversity of

water tank of Yeola in their study 56 genera and 116 species of phytoplankton ware encountered. Yadav and Ashtekar (2007) reported Desmids from Bindusara dam Beed. They found the desmids are present in large number and encountered desmids includes *Cosmarium, Closterium, Euastrum* and *Staurastrum.* Mager *et. al.,* (2007) observed algal flora of Kasura reservoir of Jalna district.. Kamble (2008) systematically studied algal biodiversity and seasonal variation of selected water bodies of Marathwada region. Further he studied biochemical analysis, antimicrobial activity of algae and effect of algal extracts on seed germination.Magar (2008) reported 364 algal taxa which mainly belongs to Chlorphyceae, Cyanophyceae , Bacillariophyceae and Eugleonophyceae from Grina reservoir of Nasik district. Andhale (2008) recorded 215 species of algae from Jayakwadi reservoir of Paithan. Talekar (2009) extensively worked on algal biodiversity of Manjara river and its reservoirs of Beed district, Maharashtra.Mahadik and Jadhav (2014),Sawdekar (2017),Jadhav and Sawdekar (2021) workedon ecologicalaspects of algae.

The above workers from Abroad and various parts of India clearly indicates changing quality of water indicating its impact on aquatic communities. Changes in aquatic communities are observed both qualitatively and quantitatively. Without knowing the local diversity of each and every habitat, it is very difficult to know the exact algal biodiversity of global. Therefore the present study is aimed to investigate a similar line.

C) Gaps in the existing research: In recent era great advances have been made in the investigation of fresh water algae, particular attention has been paid to their ecology. In the Marathwada region of Maharashtra except few reports very rare attentation has been paid towards ecological studies on algae of fresh water bodies. For new researchers lot of scope is there as large number of water bodies is present which have been explored. Extensive review of literature reveals that, selected Tawarja dam is not explored so far as ecology of algae is concerned.

D) Statement of proposed problem: In proposed research work ecological studies on algae of Tawarja dam from Latur district in the Marathwada region of Maharashtra will be carried out. Algal diversity study, abundance of algae, seasonal variation, algal bloom composition, pollution tolerant algae ,physic-chemical analysis, submerged, floating and epiphytic algal flora will be studied thoroughly.

E) Scope of Research work:

Proposed research work will cover diversity and abundance study of fresh water body. This work will highly contributing in taxonomic study of fresh water algae. It will also cover water quality management study. An emphasis will be given to study algae as a indicator of water quality. Proposed research work will entirely focused on overall ecological study of algae.

F] Aims and objectives of research: The proposed study area will be explored by keeping in mind the following objectives

1) To study diversity and abundance of algae.
2) To study algal blooms, floating, planktonic, submerged and epiphytic algae.
3) To study the class wise percentage contribution of algal flora.
4) To know the seasonal variation of algae.
5) To find out and record the pollution tolerant algal genera and species of study area.
6) To study certain physico chemical parameters for assessment of water quality.
7) To find out the correlation among algal flora and physico chemical parameters

G) Research Hypothesis-

The main aim of selecting this topic for research is that, in Latur area except very rare reports not much more work has been done. The Tawarja dam is one of the important water body in that area; so far this reservoir has not been explored as far as algal flora study and water quality management study are concerned. In the view of this fact ,there is need to study algal diversity, abundance of algae, seasonal variation, pollution tolerant algae as the water of the dam is used for drinking and irrigation purposes, algal blooms, floating, planktonic, submerged and epiphytic algal flora and physic-chemical assessment of water of this selected dam. Following points explains hypothesis of research topic.

i) Algal diversity study will enrich the knowledge of algal flora of fresh water habitats of Maharashtra.
ii) Seasonal variation study will gives an exact idea about dominance of particular algal class at particular season.
iii) More than 300 species belonging to different genera will be found.
iv) Chlorophycean (green algae) and Cyanophycean groups may be the dominant algal groups from some selected areas as the water is clean and fresh.
v) If there will be a change in the habitat, quality of water, it brings about a change in the distribution of the algal flora in the water reservoir.
vi) Algal forms will decrease as the water flows with addition of wastes. During rainy season filamentous algae will show dominant growth.
vii) Agricultural waste, domestic waste and inorganic constituents may increase the biochemical oxygen demand and chemical oxygen demand of the water.
viii) Pollution tolerant algae indicate level of pollution in water, and this is helpful in determining status of pollution in water body, especially organic pollution of water.
ix) Algal bloom study reveals eutrophication of water bodies.
x) Physico-chemical analysis of water body is significant in water quality study, this study shows quality of water and degree of pollution.
xi) Present study demonstrates the algal assemblages could be used as indicators of clean or polluted water.
xii) Clean water would support a great diversity of algae; polluted water would yield just few dominant forms.
xiii) Proposed research work is novel and will definitely contribute in the field of phycology, ecology, water quality and pollution studies in environmental biotechnology

H) Research Material and Methodology-

i) Study area:

In proposed research work experimental work will be carried out for two consecutive years.Tawarja dam, is an earthfill dam on Tawarja River near Ausa, in Latur district in the Maratwada region of Maharashtra. The study area is located in Latur and Ausa tahsils of Latur district. Tawarja river drainage basin is one of the sub basins of the river Manjra (right hand tributary of Godavari River).The dam was constructed on river Tawarja in 1982 near Utti (Khurd) and Utti (Budrukh). It is a medium size dam having the catchment area of about 250.52 km².Height of the dam above its lowest foundation is 14.3m (47ft) while the length is 2,222m (7290 ft) The volume content is $361m^3$ and gross storage capacity is 20520.00 km^2. Tawarja dam used for irrigation, livestock watering and fish production .The Tawarja dam

catchment extends between 180 14'00'' N to 180 24'00'' N latitude and 760 15'0'' E to 760 27'0'' E longitude. It originates in between sub hill ranges of Balaghat covering Maharashtra plateau.

In order to carry out the ecological studies on algae of Tawarja dam, five sites of the dam will be selected for the collection of algae and water samples. Among these selected sites four sites are standing water habitats and fifth one is running water habitat. A detailed ,systematic and scientific study on diversity of algae, abundance of algae ,seasonal variation of algae, class wise percentage contribution of algae, algal blooms, floating, planktonic, submerged and epiphytic algae, pollution tolerant algae, assessment of physic chemical parameters and its correlation will with algal flora will be conducted.

ii) Sampling design:

Algal samples will be collected at monthly intervals from five selected sites of the dam. For physico chemical assessment, water samples will be collected at seasonal intervals from selected sites.

iii) Conceptual frame work:

The main concept of this investigation is to study the algal flora of Tawaraja dam and to know diversity, abundance, dominance and frequency of algal taxa, class wise percentage contribution study of algal flora gives an idea about the dominance of particular class of algae. Seasonal variation study reveals that which season is more suitable for the algal growth. Concept of pollution tollerent algae shows level of organic pollution of the water body.Physico chemical assessment of water reveals quality of water and its role in algal diversity and abundance i.e. correlation with algal flora.

I) Research Design:

i) Collection of algal samples:

The algal samples will be collected at monthly intervals from the five selected sampling stations .Acid washed collection bottles will be used for collection of algal samples. Floating, Planktonic, submerged, epiphytic algal samples will be collected separately. Plankton nets were used to collect the planktonic algae. Field note book will be maintained in which the color of the algae, habit, habitat and dates of collection were noted, the pH of the water of the collection spots was recorded by studying at least three samples of water from three different places of the collection spots. The collection samples will be preserved in 4% formalin added with 5% glycerine for further taxonomic study.

ii) Collection of water samples:

Water samples will be collected at about 1 feet depth below surface from the dam water. The water samples will be collected in morning hour's i.e.08:00 am to 10:00am at seasonal intervals. The water samples will be collected in acid washed plastic cans of 5 liter capacity. Air temperature and water temperature will be recorded at sites by using thermometer. For the estimation of dissolved oxygen, separate water samples will be collected in 250ml/BOD glass bottles.

iii) Algal diversity study:

The diversity will be studied for quantitative analysis of algae. The fresh as well as preserved algal forms will be observed under microscope and properly identified.The measurement with the ocular and stage micrometer will be recorded for identification of different algal taxa. Generally 5 to 10 random temporary mounts were made from each collection for microscopic observations. Identification of algal taxa and the systems of classification will follow here is substantially that of Geitler (1932), Smith (1951, 1955), Prescott (1951), Pal et. al. (1952), Desikachary (1959), Randhawa (1959), Scott and Prescott (1961), Ramnathan (1962), Kriegar and Gerloff (1965), Philipose (1967), Gonzalves (1981), Iyengar and Desikachary (1981), Sarode and Kamat (1984),Research journals on algae such as Phycos,Phycologia,Indian Journal of Aquatic Biology etc. will also be referred.

iv) Physico-chemical analysis of water:

Physico-chemical analysis of water samples will be carried out by following the standard methods of APHA (1992), and Trivedi and Goyel (1986).Physical parameters such as air temperature, water temperature, pH, Turbidity, colour, hardness and the chemical parameters like alkalinity, Nitrate, Calcium, Magnesium, Potasium, Silicate, Chloride, Total dissolved solids, Free Co2, Dissolved oxygen and BOD,Chemical oxygen demand (COD) will be assessed.

v) Pollution Index:

The pollution tolerant algal genera and species will be recorded according to Palmer (1969).Site wise record of pollution tolerant algae will be studied to assess the organic pollution of water.

vi) Methods of data collection:

Data on algal diversity will be obtained after collection, observation and identification. Data on physico chemical analysis will be obtained after analysis of water samples, data on pollution tolerant algae will be analyzed as per Palmers pollution index. Algal blooms data will be recorded after careful observation at site, colonial and microscopic observations. Data on seasonal variations will be finalized on the basis of abundance of algae.

vii) Methods of data analysis:

Obtained data will be analyzed scientifically as per standard methods. Analyzed data maintained in the tubular form. Graphical representations will be also made to maintain analyzed data. Microphotographs of algae will be taken and will be presented in the form of photo plates**.**

J) Significance of study:

By knowing the local flora of each and every habitat we can enrich the national and global algal flora. The proposed investigation will definitely enrich the knowledge in the field of algal diversity, seasonal variation, class wise percentage contribution, algal blooms and pollution tolerant algae. The study will be also significant in water quality management studies and organic pollution of water .Pollution tolerant algae reveals pollution level of dam

water .Overall the proposed research work will be significant in the field of phycology, ecology, water quality management, environmental pollution and algal biotechnology.

K) A tentative chapter scheme-

Chapter 1- Introduction
Chapter 2- Review of literature
Chapter 3- Materials and Methods
Chapter 4- Taxonomic description
Chapter 5- Experimental result
Chapter 6- Discussion
Chapter 7- Summary
Chapter 8- Bibliography

L) Plan of Proposed Research work:

Sr.No.	**Time Duration**	**Expected work to be done**
1	0-06 Months	1. Extensive literature collection of concerned research proposal.
		2. Selection of sites of Tawarja dam for algal and water samples collection.
		3. Preliminary survey and collection of algal samples.
		4. Monthwise algal samples collection from selected sites of reservoir.
		5. Seasonal water samples collection from selected sites of dam
		6. Observation and identifications of algal taxa.
		7. Microphotographs to be taken of identified algal taxa.
		8. Physico chemical assessment of collected samples.
		9. Maintenance of collected research data.
2.	07-12 Months	1.Month wise algal samples collection from selected sites of reservoir
		2. Seasonal water samples collection from selected sites of dam
		3. Observation and identifications of algal taxa.
		4. Microphotographs to be taken of identified algal taxa.
		5. Physico chemical assessment of collected samples
		6. Collection of epiphytic algae/algal blooms/ planktons/submerged forms
		7. Publication of research papers in UGC listed and Peer reviewed Journals.
3.	13-18 Months	1.Month wise algal samples collection from selected sites of reservoir
		2. Seasonal water samples collection from selected sites of dam
		3. Observation and identifications of algal taxa.
		4. Microphotographs to be taken of identified algal taxa.
		5. Physico chemical assessment of collected samples
		6.Collection of epiphytic algae/ algal blooms /planktons / submerged forms
		7. Field photographs to be taken.

		8. Pollution tolerant algae recorded
4.	19-24 Months	1.Month wise algal samples collection from selected sites of reservoir
		2. Seasonal water samples collection from selected sites of dam
		3. Observation and identifications of algal taxa.
		4. Microphotographs to be taken of identified algal taxa.
		5. Physico chemical assessment of collected samples
		6. Collection of epiphytic algae/ algal blooms/ planktons/ submerged forms
		7. Field photographs to be taken.
		8. Pollution tolerant algae recorded
		9. Publication of research papers in UGC listed and Peer reviewed Journals
5.	25-30 Months	1. Analysis of collection data and presentation in tubular forms.
		2.Presentation for pre Ph.D.viva-voce
		3.Research paper publication
6.	31-36 Months	1.Thesis preparation and submission
		2. Ph.D.viva-voce presentation.

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